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ABSTRACT

Number activities for use in kindergarten were developed in an attempt to reduce the deficit in numerical experience shown by culturally disadvantaged children upon entry into the first grade. Twelve activities are described with teaching suggestions included. The activities did not undergo formal evaluation. Recommendations are made that the materials be formally evaluated, that some of the activities be performed in pre-school programs, and that certain number-learning equipment be manufactured. (Author/DT)

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PILOT STUDY FOR A NEW ELEMENTARY AND JUNIOR HIGH SCHOOL MATHEMATICS PROGRAM

June 1970

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NUMBER ACTIVITIES FOR THE KINDERGARTEN

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SUMMARY

A series of number activities for use in the kindergarten was developed in an attempt to reduce the deficit in numerical experience exhibited by culturally disadvantaged children upon entry into the first grade. The activities did not undergo formal evaluation. It is suggested that the materials be formally evaluated, that some of the activities could be performed in pre-school programs, and that certain types of number-learning equipment be manufactured for use at the kindergarten and pre-school levels.

INTRODUCTION

It is well known that a deficit in performance of mathematical tasks exists among the culturally disadvantaged at all levels of public education, and that this deficit increases with age. Considerable effort has gone into attempts to reduce or eliminate this deficit by means of remedial programs at various grade levels.

While a solution to this problem undoubtedly demands alteration of the mathematics curriculum at all levels, it is our belief that the initial focus of activity should be on that stage at which the deficit is smallest. This belief rests on the assumption that the smaller the deficit, the greater the possibility of eliminating it. This, of course, is an underlying assumption of such programs as Headstart and Follow-Through, as well.

Since it is the earliest level at which a large majority of culturally disadvantaged children are accessible to professionals, we have chosen to direct our efforts to the kindergarten. The goal of the activities described is to create a significant reduction in the deficit which exists in mathematical experiences and understandings between culturally disadvantaged children and their more fortunate peers at the point of entry into the first grade.

METHODS

A survey was made of first-grade arithmetic texts in order to determine the assumptions made by textbook writers concerning the experiential background of the first-grader. In general, it was found that the texts treated a number of basic concepts and skills very briefly and quickly moved on to work on addition. The concepts and skills referred to appear to be treated as review material. That the typical middle-class child succeeds in the tasks of first-grade arithmetic may well be attributable to the fact that for him the initial textual material is a review of experiences provided perhaps to some extent in kindergarten, but primarily outside the schools. Conversely, that many disadvantaged children do not succeed with first-grade arithmetic may be attributable to a limitation or lack of such experience.

With such ideas in mind, a list was developed of those areas in which, it was felt, special emphasis at the kindergarten level might contribute to greater success with first-grade arithmetic. The list included the following:

COUNTING:

1. rote
2. of objects
3. of pictures of objects

COMPARISON:

4. of the numbers of two or more sets of objects
5. of two or more equivalent sets of objects

COUNTING:

6. one more - rote
7. one less - rote
8. one more by adding object
9. one less by removing object

NUMERALS:

10. names of the numerals

11. association of numerals with sets of objects

12. ordering of numerals without associated objects

13. one more, using numerals

14. one less, using numerals

The list shown was used as the basis for the development of the group of kindergarten activities shown as Appendix A. Each activity included was designed to meet the following criteria:

1. Contributes to one or more of the skills listed above.

2. In keeping with the capacities of disadvantaged kindergartners at some point during the year (assuming, in many cases, that earlier activities from the group shown have been completed successfully).

3. Requires only materials that are readily available, or that can be easily constructed from available materials.

Many of the activities included actually consist of a series of activities of increasing complexity, so that they may be returned to in altered form as the child's level of proficiency increases through the year. The activities shown are ordered on the basis of the complexity of the initial task described in each category. The point at which children should move to a more complex task within a category is left to the judgment of the teacher.

Because of financial and time limitations, the activities shown as Appendix A have not undergone the type of formal evaluation and trial necessary to provide an indication of their value in achieving the goal of improved performance in first-grade arithmetic.

In the fall of 1970 three kindergarten teachers in the Berkeley Unified School District, Berkeley, California, provided a subjective evaluation of the various activities. The essence of their remarks is reported below in the same order as that used in Appendix A.

Number Songs

"The children enjoy these songs."

"Consider also using nursery rhymes: "One, Two, Buckle My Shoe; Hot Cross Buns; One Potato, Two Potato; Mary at the Cottage Door; Sing a Song of Sixpence."

Counting Games

#1: "May be hard or demanding for some children. Note that the game collapses if one child errs."

"Very good. Children play this without teacher direction after the first few times."

#2: "I've done this. I like it."

"Good."

#3: "Good, but the children are likely to remember the order of people, not numerals."

#4: "If the 'it' child takes quite awhile, the others get restless."

"Good."

"I like this very much."

One-More, One-Less Song

"Consider having the children hold beans and transfer them from one hand to the other when singing the appropriate number."

Snack-Time Arithmetic

"Crackers may also be used for teaching shapes. Different brands include circles, triangles, squares, rectangles, pentagons, hexagons, and ellipses."

"Many uses of number arise naturally at snack-time. There is no need to manufacture artificial ones."

Feely-Box

"I want to try this."

"I think this is confusing."

"Selecting the numeral corresponding to the number of objects counted is good in itself, without the feely-box."

Matching Sets

"I have used this with many variations."

"As an alternative, use flannel board pieces of different shapes for boys and girls. Each child calls out the next number as he puts up his piece. Then the two shapes are matched to see if there is more of one shape."

Play Store Arithmetic

"We do this with counters, rather than pennies."

"I plan to try this with first-graders."

Locker Numbers

"This seems good, if you have lockers or something else you could use."

"Go slowly on this one. It is too frightening to do early in the year."

Identification and Ordering of Numerals

"Have the children make paper hats themselves."

Hop-Scotch

"Good."

"I have seen children carry this over to the playground."

Mathematical Music

"Good."

General Comments:

"These seem very workable and delightful math activities for the young child. The aspect of integrating music with core subjects I have always found successful and of interest to the children. To involve their own bodies in learning could possibly improve self-image as well as help in obtaining our math goals."

"My general feeling is that contrived games and special situations are unnecessary for the most part. Children's play naturally provides a great wealth of opportunities for teaching and reinforcing number concepts."

CONCLUSIONS AND RECOMMENDATIONS

For the reasons stated under "Results and Findings" conclusions cannot be offered at this point. A formal trial and evaluation of the materials developed would be highly useful. Such an evaluation should ideally include pre-test information on both experimental and control groups at time of entry into kindergarten and comparable post-test information at either the close of the kindergarten year or the beginning of the first grade, along with a description of the amount of time actually spent on the various activities during the year. A subsequent experimental-control comparison at the close of the first grade would also provide useful information.

Since a number of the activities developed would be accessible to pre-school children, it is suggested that they might be tried in pre-school programs, particularly those that include disadvantaged children.

In the course of the development of the activities, two types of equipment were conceived of which do not exist at present, as far as we have been able to determine. It is felt that both types would be useful adjuncts to existing kindergarten (and pre-school) equipment, if their commercial manufacture were feasible. A description of the equipment is shown as Appendix B.

APPENDIX A

NUMBER SONGS

There are many folk songs which provide an opportunity to combine musical experience with number learning. The following is a partial list of such songs with an indication of the number sequences they include:

1. "Buffalo Gals" - (1-4)
2. "Johnny Works with One Hammer" - (1-5)
3. "The Eight Little Indians" - (1-8)
4. "By'n By" - (1-9)
5. "Band of Angels" - (1-10)
6. "New River Train" - (1-10)
7. "Knick Knack" ("This Old Man") - (1-10)
8. "Who Built the Ark? Noah, Noah" - (1-10)
9. "The Story of Twelve" (reverse order, 12-1)
10. "Three Craw" (ordinals, 1st-4th)

The songs listed appear in a variety of song books. One source is given below for each.

2,3,8 - This Is Music, Adeline McCall, Allyn and Bacon, 1966

4,5,9 - Songs to Grow On, Beatrice Landeck, 1950

6,10 - More Songs to Grow On, Beatrice Landeck, 1954

1,7 - The Best Singing Games, Edgar S. Bley, 1957

COUNTING GAMES (for groups up to ten)

1. Have the children line up in a row. Then have them count off, each child supplying the next number in sequence. (Note that if the children count off from left to right from their points of view, the sequence will move from right to left from the observer's point of view. If other children are observing, you may prefer to have the "counters" form a column.)

2. Give each child a card with a different numeral and the corresponding number of dots or designs. Have the children arrange themselves in numerical order through discussion with one another. Then have them count off, each child giving his number in turn. Each child should display his card so that you may check for accuracy. At a later stage, change to cards which show numerals only.

COUNTING GAMES (continued)

3. Hang numeral cards on each child. Have them line up in numerical order, except that one child is out of place. The child who is "it" must find the wrongly placed child and take him to the correct place. Then the child who was originally out of place becomes "it." He gives his numeral card to the first child who was "it." Then he hides his eyes while another child moves out of order. Attempt to get the child who is "it" to verbalize his thinking, e.g., "Johnny belongs here because four comes after three."

4. For a more complicated version of Game 3, have the children line up in correct numerical order. The child who is "it" is given a numeral card that duplicates one of the others. His task is to take his card to the child who is one more (or one less) than his number. He then becomes one of the children in line and the receiving child becomes "it." The new child who is "it" starts over with a new duplicate card to take to the correct child. After the children are familiar with this game, complicate the task by having them line up at random. Note that the "it" child should not be given the numeral "1" in the "less than" game or a duplicate of the largest numeral in the "more than" game.

NOTE: For Games 3 and 4, the children in the row should be ordered from their own right to left, since the "it" child will be facing them.

SILENT COUNTING

Start by having the children count aloud as you repeat the same tone on a xylophone or tone bell -- (tone), "one," (tone), "two," (tone), "three," etc. When they are familiar with this procedure, explain that you will make a certain number of tones and that they are to count the tones silently and then tell you how many there were. For example: (tone) (tone) (tone) (tone) -- "How many?" (four).

As experience grows, increase the tempo in order to force greater speed of silent counting. You may also wish to allow individual children to produce the tones.

ONE-MORE, ONE-LESS SONG

The song shown below is intended as a ritual experience, to be performed each day until the need for it no longer exists. It might well be performed immediately after the Pledge of Allegiance.

One possible approach to the song is as follows:

"I've got one" (teacher) (holds up numeral poster "1")

"One more makes two" (children)

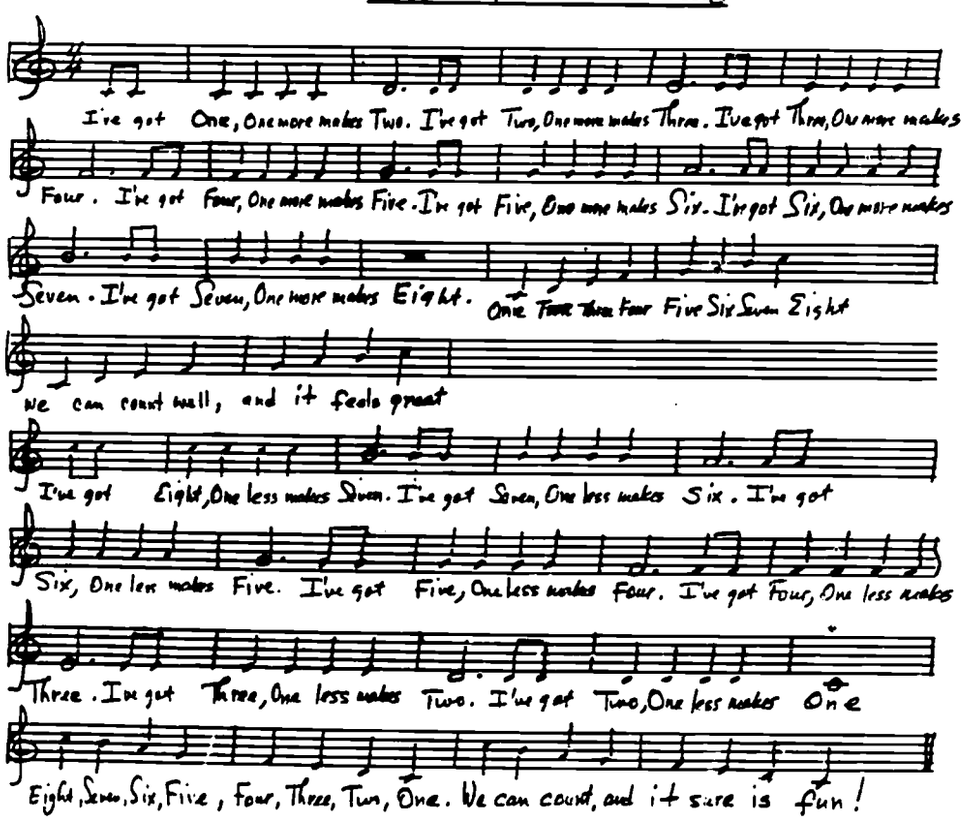
"I've got two" (teacher) (holds up numeral poster "2")

"One more makes three" (children)

etc.

At a later stage, a different child might be selected each day to hold up the numeral posters. The possibility also exists of teacher or child accompaniment on the xylophone.

One-More, One-Less Song



SNACK-TIME ARITHMETIC

Give children various numbers of oyster crackers. If a child can state the number correctly, he is permitted to eat the crackers. Ask how many are left after each cracker is eaten.

A play man with a transparent bag for a stomach may be used to represent the eating. Each time the child eats a cracker, a cracker goes into the play man's stomach. By counting the crackers in the bag, the child can determine how many he has eaten.

FEELY-BOX

Have children reach inside the box and determine the number of objects inside without visual clues. To avoid the possibility of counting the same object more than once, demonstrate (without the box) how all of the objects may be pushed to one side and then removed to the opposite side as they are counted.

The activity may be extended to include numerals by having a child select the plastic numeral that corresponds to the number of objects he has counted.

MATCHING SETS

Display a number of donkeys on a flannel board or pin board. Display a number of tails separately. Have the children attach a tail to each donkey. Ask them to determine whether there are more or less tails than donkeys, or the same number. How many more, or less?

Later, extend the activity to the matching of two sets of objects that have no logical connection (e.g., blocks and crayons). Eventually have the children compare the numbers of two sets without manipulation by means of counting the members of each set and deciding which number is "more."

PLAY STORE ARITHMETIC

Give each child a small sack containing ten play pennies. Have the children use their pennies to buy the use of articles from the play store. The objects should range in price from one to ten cents, and the price should be clearly marked on each one. In a recitation section, have children describe what they bought, how much it cost, and how many pennies they have remaining.

PLAY STORE ARITHMETIC (continued)

Alternatives:

Two children could pool their resources to buy an object that costs more than either of them has left. There are also various possibilities involving re-sale or trade of items. For example, a child might offer a six-cent item and two pennies in exchange for an eight-cent item. Bargaining might also be introduced in which a child attempts to re-sell an item at either a profit or a loss.

LOCKER NUMBERS

In classrooms having lockers, label each locker with a large numeral and the corresponding number of dots or other designs. Label the first ten lockers with "1" through "10" and then start a new series. Start over each time ten is reached. Make the numerals and designs a different color for each series.

Tell each child the number and color for his locker, for example, 7 - green. Show him how he can find his locker with this information, i.e., by going to the far left locker in the appropriate color series and counting off lockers until he reaches his own number. Be sure that all counting is done from left to right. For this first activity, it would be useful for each child to have a card that is a duplicate of his locker label.

Show how a child can count the dots (or designs) on his locker to make sure that he has the right one.

Give a child a card with five green dots on it. Ask him to take it to the proper locker. Repeat with other colors and quantities of dots.

Ask a child to go to the locker with 7 blue dots. Repeat with other combinations.

Give a child a card with a red numeral 3 on it. Ask him to take it to the proper locker. Repeat with other combinations.

Hold up a large numeral. Ask which children have this numeral on their lockers. Continue with other numerals.

Remove a single locker label. Ask a child (other than the owner) what numeral goes on that locker, or how many dots go on it. Repeat with other lockers after replacing the first label.

LOCKER NUMBERS (continued)

Demonstrate that each locker in a color series has one more dot than the locker to the left of it and one less dot than the locker to the right of it. Show how one may choose any locker in his color series, count the dots, and decide whether his own locker is to the left or the right ("Are there enough dots? Are there too many?")

Ask who has the first locker with a red label, with a green label, etc. Associate "first" with "farthest to the left" and with one dot and with the numeral 1. Explain that one is the "first" number. Repeat with "second," associating it with "comes after first" and with two dots and the numeral 2. Repeat with "third."

Since each child will become most familiar with the numeral for his own locker, you may wish to consider having the children change lockers from time to time during the year. One way to do this is to have each child move one locker to the right, with number ten going to number one.

IDENTIFICATION AND ORDERING OF NUMERALS

Distribute ten hats each of which displays a large numeral and the corresponding number of dots. The child with #1 puts his hat on, stands up, and says, "I am one." The child with #2 then puts his hat on, stands up, and says, "I am one more than one. I am two." Continue through ten. The activity may also be conducted backward for work on the "one less" concept.

The dots enable the child who does not recognize his numeral to determine its value by counting. Once facility in the identification of numerals is attained, the dots should be removed.

Alternatives:

Cards with string attached so that they may be hung around the children's necks could be substituted for the hats.

With all of the hats on (or cards attached to) children, a variety of questions may be asked. For example, "Who is Billy?" (e.g., 4) "Who is one more than Billy?" (Mary) "Who is Mary?" (5) "Who is more than anybody else?" "Who is 3?" "Who is one less than 7?"

HOP-SCOTCH

Hot-scotch games may be used to teach recognition and ordering of numerals. Various levels of complexity may be introduced by altering the positions of the various numbered squares. The "one less" concept may be introduced by having the children traverse the squares in reverse numerical order.

MATHEMATICAL MUSIC

Label a set of melody bells or a xylophone with numerals so that do is 1, re is 2, mi is 3, etc. Give children numerical directions that will produce familiar melodies. For example,

3 3 3 3 3 3 3 5 1 2 3

Jin- gle bells, jin- gle bells, jin- gle all the way!

APPENDIX B

NUMBER PUZZLES

Each of the puzzles described below should consist of ten interlocking pieces which fit together in a horizontal row in only one way. The material should be plywood, or possibly plastic.

Puzzle #1: Each piece should have an appropriate number of dots (or other designs) arranged for finger-counting. It would be useful to have the dots either raised or recessed.

Puzzle #2: Same as Puzzle #1, except that each piece should have, in addition to the dots, the appropriate numeral. The numeral should be recessed and large enough so that it can be traced with the child's finger.

Puzzle #3: Same as Puzzle #2, except with the dots removed.

Activities:

1. Have individual children construct Puzzle #1, until proficiency is gained. Then substitute Puzzle #2. At this stage, it is expected that the proficiency with #1 will carry over to #2, since the dots are still present. Allow children to continue with #2 until interest lags. Then substitute Puzzle #3.

2. Another possibility is to use only Puzzle #3. In this case, children will start with no clues other than the shapes of the pieces. Some children may gain proficiency with no assistance. For others, it may be necessary to substitute Puzzles #2 or #1 and later return to Puzzle #3.

ELECTRIC NUMBER BOX

This device should consist of a box with a recessed horizontal slot in the top. Ten square tiles with large recessed numerals should fit into the slot. When the 1-tile is placed at the far left, a bulb lights up directly above the tile. When the 1-tile and the 2-tile are in position, a second bulb above the 2-tile lights up. (A 2-tile in the correct position without the 1-tile should light no bulbs.) When all tiles are correctly placed, there should be a lighted bulb above each tile.

ELECTRIC NUMBER BOX (continued)

Activities:

The electric number box should be used only after the child has gained proficiency with number Puzzle #3. Since there are 3,628,800 different ways of placing the tiles at random, the task is too difficult for children who do not have at least some familiarity with numerals, unless strategy is discussed with them. Each of the tiles may be tried in the "1" position until the bulb lights, each of the remaining tiles may be tried in the "2" position until its bulb lights, etc. The advantage over Puzzle #3 is that the tiles are not distinguishable on the basis of shape.

Separate sets of tiles having dots only and dots plus numerals could be supplied, thus duplicating the function of Puzzles #1 and #2.